furnaces it may be said that few of them are good and that the process of heat-treating which is actually in use is less satisfactory than the tempering process.

For heat-treating or temper-drawing furnaces, the temperature must be maintained at less than 700°, that is to say, at a temperature at which the reactions of combustion can scarcely take place, and for this reason the gas must be burned outside the furnace; after this it is necessary to cool it in a special combustion chamber, to the temperature required. It is then passed into the heating chamber of the furnace and heats this last in a uniform manner to 400°, 500°, 600°, according to the requirements of the work.

The furnaces for the tempering of the tubes and jackets for large guns are built as pits with fireboxes at different levels, the waste gases being taken off at the highest part of the pit. The cannon are rotated on their axis during this operation. Reheating these gun parts is done in the same manner in Russia as in the rest of Europe, except that in Russia wood fuel is used, as it is considered better than coal for this purpose. Recently it has been found that these furnaces could be heated with gas, combustion being effected by a large number of burners arranged spirally around the chamber.

Two errors are committed in the design of these furnaces:

1. The high-temperature flaming gases of the burner are produced in the heating chamber;

2. The waste gases are drawn off at the top of the furnace.

With this system the heating of pieces as long as 18 m is a matter of considerable difficulty, and it is evident that in the furnaces for the tempering of such gun tubes, it is necessary to make use of the downdraft principle. Just what must be done to obtain this result is shown more accurately by the drawing (Fig. 99) of a furnace which is in use in one of the large works for tempering

heavy field artillery jackets. The flame is developed in a firebox independent of the furnace, from which the hot gases rise into the free spaces located on both sides of the heating chamber, entering the latter through a number of small orifices or ports; then, rising to the top of the chamber, they are carried off by the waste-gas flue. Taking these gases off at the top spoils the furnace. If its designer had located the waste-gas port at the level of the hearth of the heating chamber he would certainly have obtained a much more uniform operating condition.